allowed claims for the above-referenced cases and then reconsider the double patenting rejection in view of such allowed claims.

F. The Claims Are Not Obvious Over Tsai Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1883-1889, 1893-1906, 1909-1911, and 1916-1918 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. (hereinafter "Tsai"). Applicant respectfully disagrees with these rejections.

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 U.S.P.Q. 173, 177-178 (C.C.P.A. 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

Amended claim 1883 describes a combination of features including: "providing heat from one or more heaters to at least a portion of the formation; allowing the heat to transfer from the portion of the formation to a part of the formation." Applicant submits that support for the amendment can be found at least in the specification, thus adding no new matter, on page 40, lines 1-3 "A heat source may also include a heater that may be configured to provide heat to a zone proximate to and/or surrounding a heating location such as a heater well." In addition, "A "heater" is generally defined as any system configured to generate heat in a well or a near wellbore region." (Specification, page 40, lines 6-7).

Tsai states:

> The in situ gasification of coal by the partial underground combustion of the coal requires at least one hole or well drilled from the surface to the coal deposit for the injection of the oxidizing gas and at least one appropriately spaced production hole or well for the delivery to the surface of the combustible product gas. And most importantly, the gasification process requires a low resistance, high

> porosity route in the coal bed between the injection hole and the production hole so that large volumes of the oxidizing gas, generally air but also including oxygen-enriched air, can be introduced into the coal deposit at low pressure to support substantial combustion and concurrently deliver large volumes of the desired combustible gas product to the production hole.
> (Tsai, column 1, lines 46-60).

In addition, Tsai states:

> The pretreatment and conditioning of the swelling coal before the in situ combustion and gasification procedure is initiated involves the injection of heated air into the injection hole at sufficient pressure to fracture the coal, and the injection of the heated air through the fracture to the production hole without combustion of the coal. The temperature of this heated air should be at least about 100 °C. and preferably at least about 150 °C. in order to provide an effective pretreatment and conditioning as evidenced by an increased permeability and porosity and a reduced swellability of the coal proximate to the linkage. Since the injection of the heated air should itself not cause the coal to swell, the maximum temperature of the injected air can be up to but not the same as the temperature at which the coal begins to soften, i.e., the softening temperature of the coal. This softening temperature is a property specific to each particular coal (for the determination of the softening temperature of a coal see pages 152-155 of Chemistry of Coal Utilization, Supplementary Volume, 1963, edited by H. H. Lowry). In general, we prefer that the temperature of the heated air be a maximum of about 350 °C. and most prefer that the maximum temperature be about 300 °C. The range of about 150 °C. to about 300 °C. is a particularly suitable operating range.
> (Tsai, column 3, lines 21-45).

Tsai, does not appear to teach or suggest at least the feature of heating at least a portion of a formation with one or more heaters and allowing heat to transfer from the portion of the formation to a part of the formation, in combination with the other features of the claim. Applicant requests removal of the obviousness rejection of claim 1883 and the claims dependent thereon.

If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Applicant submits, however, that many of the claims dependent on claims 2309 and 2348 are

separately patentable.

For example, the Examiner states "With regards to claim 1884; the Tsai reference fails to explicitly teach the superposition of heat sources. It is apparent that one of ordinary skill in the art would know that the heat sources should be spaced to substantially heat the entire formation." Applicant respectfully disagrees.

Claim 1884 recites, in part "wherein one or more of the heaters comprise at least two heaters, and wherein controlled superposition of heat from at least two heaters pyrolyzes at least some hydrocarbons within the part of the formation." Applicant submits that support for the amendment can be found at least in the specification, thus adding no new matter, on page 12, lines 17-27. The features of claim 1884, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

The Applicant's specification discloses:

> One or more heat sources may be located within the formation such that superposition of heat produced from one or more heat sources may occur. Superposition of heat may increase a temperature of the selected section to a temperature sufficient for pyrolysis of at least some of the hydrocarbons within the selected section. Superposition of heat may vary depending on, for example, a spacing between heat sources. The spacing between heat sources may be selected to optimize heating of the section selected for treatment. Therefore, hydrocarbons may be pyrolyzed within a larger area of the portion. In this manner, spacing between heat sources may be selected to increase the effectiveness of the heat sources, thereby increasing the economic viability of a selected in situ conversion process for hydrocarbons. Superposition of heat tends to increase the uniformity of heat distribution in the section of the formation selected for treatment. (Specification, page 12, lines 16-26).

Tsai does not appear to teach or suggest the controlled superposition of heat from heaters to pyrolyze at least some hydrocarbons in a formation. Applicant respectfully submits that the Examiner's rejection of the features of claim 1884, in combination with the features of independent claim 1883, as obvious matters of choice or design may rely upon personal

knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

Claim 1885 recites, in part "further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range." The features of claim 1884, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

The Examiner states "With regards to claim 1886, electrical heaters are well known to heat air. It would have been obvious to one of ordinary skill in the art at the time of the invention to have used an electrical heater with the Tsai process as called for in claim 1886, in order to heat the air." Applicant respectfully disagrees.

Claim 1886 recites, in part "wherein one or more of the heaters comprise electrical heaters." The features of claim 1886, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

Tsai does not appear to teach, suggest or provide motivation for the use of "heaters" in general, as described, and more specifically does not appear to teach or suggest the use of electrical heaters. Applicant respectfully submits that the Examiner's rejection of the features of claim 1886, in combination with the features of independent claim 1883, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

The Examiner states "With regards to claim 1887, surface burners are well known to heat air. It would have been obvious to one of ordinary skill in the art at the time of the invention to have used a surface burner with the Tsai process as called for in claim 1887, in order to heat the air." Applicant respectfully disagrees.

Claim 1887 recites, in part "wherein one or more of the heaters comprise surface burners." The features of claim 1887, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

Tsai does not appear to teach, suggest or provide motivation for the use of "heaters" in general, as described, and more specifically does not appear to teach or suggest the use of surface burners. Applicant respectfully submits that the Examiner's rejection of the features of claim 1887, in combination with the features of independent claim 1883, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

The Examiner states "With regards to claim 1888, the Tsai reference teaches a flameless combustor (see col. 2, line 32)." Applicant respectfully disagrees.

Claim 1888 recites, in part "wherein one or more of the heaters comprise flameless distributed combustors." The features of claim 1888, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

Tsai states:

> Heretofore, when the link has been prepared in a non-swelling coal such as a sub-bituminous coal, the oxidizing gas is injected into the injection hole at an

> appropriate rate and the fire is started in the coal bed at the injection well. This causes a series of reactions and processes to occur simultaneously including volatilization, pyrolysis, oxidation, reduction, and the like, with the result that a combustible product gas is delivered at the production well. However, when a swelling coal, such as a medium-volatile bituminous coal, is ignited, the coal in the link proximate to the flame heats up above its softening temperature and expands until the linkage is eventually plugged whereupon the gas flow stops and the fire extinguishes.
> (Tsai, column 2, lines 30-43).

Tsai appears to teach or suggest providing an oxidizing gas to the formation and starting a fire in the coal formation, burning the formation. Tsai does not appear to teach, suggest, or provide motivation for a flameless distributed combustor.

The Examiner states "With regards to claim 1889, the Tsai reference teaches a natural distributed combustor (see col. 2, line 32)." Applicant respectfully disagrees.

Claim 1889 recites, in part "wherein one or more of the heaters comprise natural distributed distributed combustors." The features of claim 1889, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

Tsai states:

> Heretofore, when the link has been prepared in a non-swelling coal such as a sub-bituminous coal, the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well. This causes a series of reactions and processes to occur simultaneously including volatilization, pyrolysis, oxidation, reduction, and the like, with the result that a combustible product gas is delivered at the production well. However, when a swelling coal, such as a medium-volatile bituminous coal, is ignited, the coal in the link proximate to the flame heats up above its softening temperature and expands until the linkage is eventually plugged whereupon the gas flow stops and the fire extinguishes.
> (Tsai, column 2, lines 30-43).

Applicant's specification discloses:

> As used herein, the phrase "natural distributed combustor" generally refers to a heater that uses an oxidant to oxidize at least a portion of the carbon in the formation to generate heat, and wherein the oxidation takes place in a vicinity proximate to a wellbore. Most of the combustion products produced in the natural distributed combustor are removed through the wellbore.
> (Specification, page 40, lines 19-23).

Tsai appears to teach or suggest providing an oxidizing gas to the formation and starting a fire in the coal formation, burning the formation. Tsai does not appear to teach, suggest, or provide motivation for a natural distributed combustor wherein the oxidation takes place in a vicinity proximate to a wellbore.

The Examiner states:

> With regards to claim 1893; the Tsai reference does not explicitly teach the transferring by conduction; however this inherent in a solid substance such as coal. Even though the bulk of the heating in the Tsai method may be done by convection; it is apparent that some unfractured coal must remain, and thus the allowing heat to transfer comprises transferring heat substantially by conduction (that is, substantially within the unfractured portions).

Applicant respectfully disagrees.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck,* 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991), MPEP § 2143.

Claim 1893 recites, in part "wherein allowing the heat to transfer comprises transferring heat substantially by conduction." The features of claim 1893, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

The Examiner states:

> With regards to claim 1894; the Tsai reference does not teach the thermal conductivity; however, it would have been further obvious to one of ordinary skill in the art at the time of the invention to have practiced the Tsai method in a coal seam having a thermal conductivity of greater than about 0.5W/(m°C) as called for in claim 1894; such a formation would be a desirable choice because it would heat more uniformly.

Applicant respectfully disagrees.

The totality of the prior art must be considered, and proceeding contrary to accepted wisdom in the art is evidence of nonobviousness. *In re Hedges*, 783 F.2d 1038, 228 USPQ 685 (Fed. Cir. 1986), MPEP § 2145.

Claim 1894 recites, in part "wherein providing heat from one or more of the heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C)." The features of claim 1894, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

In addition, Applicant submits that providing heat from one or more heaters such that a thermal conductivity of a portion of a formation is greater than about 0.5 W/(m °C) is unexpected based on literature in the art. For example, Applicant's specification states:

> Certain embodiments described herein will in many instances be able to economically treat formations that were previously believed to be uneconomical. Such treatment will be possible because of the surprising increases in thermal conductivity and thermal diffusivity that can be achieved with such embodiments. These surprising results are illustrated by the fact that prior literature indicated that certain hydrocarbon containing formations, such as coal, exhibited relatively low values for thermal conductivity and thermal diffusivity when heated. For example, in government report No. 8364 by J. M. Singer and R. P. Tye entitled "Thermal, Mechanical, and Physical Properties of Selected Bituminous Coals and Cokes," U.S. Department of the Interior, Bureau of Mines (1979), the authors report the thermal conductivity and thermal diffusivity for four bituminous coals. This government report includes graphs of thermal conductivity and diffusivity that show relatively low values up to about 400 °C (e.g., thermal conductivity is

about 0.2 W/(m °C) or below, and thermal diffusivity is below about 1.7 x 10^{-3} cm^2/s). This government report states that "coals and cokes are excellent thermal insulators."

In contrast, in certain embodiments described herein hydrocarbon containing resources (e.g., coal) may be treated such that the thermal conductivity and thermal diffusivity are significantly higher (e.g., thermal conductivity at or above about 0.5 W/(m °C) and thermal diffusivity at or above 4.1 x 10^{-3} cm^2/s) than would be expected based on previous literature such as government report No. 8364. If treated as described in certain embodiments herein, coal does not act as "an excellent thermal insulator." Instead, heat can and does transfer and/or diffuse into the formation at significantly higher (and better) rates than would be expected according to the literature, thereby significantly enhancing economic viability of treating the formation.
(Specification, page 150, line 18 to page 151, line 10).

Thus, Applicant submits that providing heat from one or more heaters heating a portion of the formation such that a thermal conductivity of at least a part of the formation is greater than about 0.5 W/(m °C) is not an obvious matter of choice or design. Applicant respectfully submits that the Examiner's rejection of the features of claim 1894, in combination with the features of independent claim 1883, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

The Examiner states:

With regards to claims 1895-1906, 1910, and 1911; the nature of hydrocarbons produced from such heating is highly variable, and dependent upon many factors, not least of which is the characteristics of the coal. The components of the produced mixture are deemed to be the results of design variables, including coal characteristics and temperature. Also, specifically with respect to claims 1898-1900; hydrocarbons produced using the Tsai method inherently have less than 1% nitrogen, oxygen, or sulfur.

Applicant respectfully disagrees.

Applicant submits that the product mixtures recited in claims 1895-1906, 1910, and 1911 would not be producible by carrying out the in situ combustion process of Tsai. The product mixtures recited in claims 1895-1906, 1910, and 1911 may be produced by controlling and/or modifying formation conditions during treatment to produce the selected results recited in the claims.

For example, "Certain embodiments may include altering a composition of formation fluids produced from a hydrocarbon containing formation by altering a location of a production well with respect to a heater well." (Specification, page 18, lines 4-6). In addition, the specification states:

> In an embodiment, compositions and properties of formation fluids produced by an in situ conversion process for hydrocarbons may vary depending on, for example, conditions within a hydrocarbon containing formation. (Specification, page 17, lines 1-3).

The specification further states: "Controlling pressure, heat and/or heating rates of a selected section in a formation may increase production of selected formation fluids." (Specification, page 17, lines 13-14).

An example cited in the specification discloses:

> FIG. 112 illustrates a plot of the weight percent of specific carbon numbers of hydrocarbons within the produced hydrocarbon liquids. Curve 3620 represents the carbon distribution for the composite mixture of hydrocarbon liquids over the entire in situ conversion process ("ICP") field experiment. For comparison, a plot of the carbon number distribution for hydrocarbon liquids produced from a surface retort of the same Green River oil shale is also depicted as curve 3622. In the surface retort, oil shale was mined, placed in a vessel, rapidly heated at atmospheric pressure to a high temperature in excess of 500 °C. As illustrated in FIG. 112, a carbon number distribution of the majority of the hydrocarbon liquids produced from the ICP field experiment was within a range of 8 to 15. The peak carbon number from production of oil during the ICP field experiment was about 13. In contrast, the surface retort 3622 has a relatively flat carbon number distribution with a substantial amount of carbon numbers greater than 25. (Specification, page 233, lines 1-12)

Tsai states:

> The coal used in these experiments was a highly-swelling bituminous coal from the Pocahontas seam in a mine near Bluefield, West Virginia. It had a free-swelling index of 8.5, a volatile content of 31 percent, an ash content of 2.12 percent and a heating value of 15,200 Btu/lb (8,460 kcal/kg). Elemental analysis showed 84.73 percent carbon, 4.63 percent hydrogen, 3.1 percent oxygen and 0.59 percent sulfur. Nitrogen was not determined.
> (Tsai, column 6, lines 43-51).

Tsai does not appear to teach or suggest controlling formation conditions for the purpose of producing a mixture from a formation with specific elements within specific limitations. Applicant submits that the product mixtures recited in claims 1895-1906, 1910, and 1911, in combination with the features of independent claim 1883, would not necessarily or obviously occur in carrying out the in situ combustion process of Tsai. Thus, Applicant respectfully submits that the Examiner's rejection of claims 1895-1906, 1910, and 1911 as obvious may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

Claim 1909 recites, in part "further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute." The features of claim 1909, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

Claim 1916 recites, in part "wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy." The features of claim 1916, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

The Examiner states "With regards to claims 1916 and 1917; the Tsai reference teaches

the permeability greater than about 100 md in table 1. The uniform increase in permeability is inherent." Applicant respectfully disagrees.

Claim 1917 recites, in part "wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation." The features of claim 1917, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

Applicant submits that a section of a formation may be heated to not only increase the permeability of the formation, but also increase the permeability in a "uniform" manner. There are many advantages, as outlined in the specification, to uniformly increasing the permeability of a formation with heat. In addition, Applicant submits that the specification discloses how to heat a formation to uniformly increase the permeability.

Applicant's specification states:

> In some embodiments, superposition (e.g., overlapping) of heat from one or more heat sources may result in substantially uniform heating of a portion of a hydrocarbon containing formation. Since formations during heating will typically have temperature profiles throughout them, in the context of this patent "substantially uniform" heating means heating such that the temperatures in a majority of the section do not vary by more than 100 °C from the assessed average temperature in the majority of the selected section (volume) being treated.
>
> Substantially uniform heating of the hydrocarbon containing formation may result in a substantially uniform increase in permeability. For example, uniformly heating may generate a series of substantially uniform fractures within the heated portion due to thermal stresses generated in the formation. Heating substantially uniformly may generate pyrolysis fluids from the portion in a substantially homogeneous manner. Water removed due to vaporization and production may result in increased permeability of the heated portion. In addition to creating fractures due to thermal stresses, fractures may also be generated due to fluid pressure increase. As fluids are generated within the heated portion a fluid pressure within the heated portion may also increase. As the fluid pressure approaches a lithostatic pressure of the heated portion, fractures may be generated. Substantially uniform heating and homogeneous generation of fluids may generate substantially uniform fractures within the heated portion. In some

embodiments, a permeability of a heated section of a hydrocarbon containing formation may not vary by more than a factor of about 10.
(Specification, page 152, lines 7-27).

Applicant's specification further states:

Heating the portion of a hydrocarbon containing formation, as described in any of the above embodiments, may substantially uniformly increase a porosity of a selected section within the heated portion. In the context of this patent "substantially uniform porosity" means that the assessed (e.g., calculated or estimated) porosity of any selected portion in the formation does not vary by more than about 25 % from the assessed average porosity of such selected portion.

Physical characteristics of a portion of a hydrocarbon containing formation after pyrolysis may be similar to those of a porous bed. For example, a portion of a hydrocarbon containing formation after pyrolysis may include particles having sizes of about several millimeters. Such physical characteristics may differ from physical characteristics of a hydrocarbon containing formation that may be subjected to injection of gases that burn hydrocarbons in order to heat the hydrocarbons. Such gases injected into virgin or fractured formations may tend to channel and may not be uniformly distributed throughout the formation. In contrast, a gas injected into a pyrolyzed portion of a hydrocarbon containing formation may readily and substantially uniformly contact the carbon and/or hydrocarbons remaining in the formation. In addition, gases produced by heating the hydrocarbons may be transferred a significant distance within the heated portion of the formation with a minimal pressure loss. Such transfer of gases may be particularly advantageous, for example, in treating a steeply dipping hydrocarbon containing formation.

Synthesis gas may be produced from a portion of a hydrocarbon containing formation containing, e.g., coal, oil shale, other kerogen containing formations, heavy hydrocarbons (tar sands, etc.) and other bitumen containing formations. The hydrocarbon containing formation may be heated prior to synthesis gas generation to produce a substantially uniform, relatively high permeability formation. In an embodiment, synthesis gas production may be commenced after production of pyrolysis fluids has been substantially exhausted or becomes uneconomical. Alternately, synthesis gas generation may be commenced before substantial exhaustion or uneconomical pyrolysis fluid production has been achieved if production of synthesis gas will be more economically favorable. Formation temperatures will usually be higher than pyrolysis temperatures during synthesis gas generation. Raising the formation temperature from pyrolysis temperatures to synthesis gas generation temperatures allows further utilization of heat applied to the formation to pyrolyze the formation. While raising a temperature of a formation from pyrolysis temperatures to synthesis gas temperatures, methane and/or H_2 may be produced from the formation.

(Specification, page 153, line 4, through page 154, line 7).

Tsai does not appear to teach, suggest, or provide motivation for heating a section of a formation to increase the permeability in a uniform manner. Applicant submits that the increase in permeability in a uniform manner as recited in claim 1917 would not necessarily or obviously occur in carrying out the in situ combustion process of Tsai. Thus, Applicant respectfully submits that the Examiner's rejection of claim 1917, in combination with the features of independent claim 1883, as obvious may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

The Examiner states "With regards to claim 1918, although the Tsai reference fails to explicitly disclose a Fischer Assay; it is apparent that the disclosed process will yield greater than 60%." Applicant respectfully disagrees.

Claim 1918 recites, in part "further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by Fischer Assay." The features of claim 1918, in combination with the features of the independent claim 1883 do not appear to be taught or suggested by the cited art.

Tsai does not appear to teach, suggest or provide motivation for controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by Fischer Assay. Applicant respectfully submits that the Examiner's rejection of the features of claim 1918, in combination with the features of independent claim 1883, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to

the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

G. The Claim Is Not Obvious Over Tsai In View of Elkins Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claim 1890 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 2,734,579 to Elkins (hereinafter "Elkins"). Applicant respectfully disagrees with these rejections.

The Examiner states:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to have further modified the Tsai process to have included the temperature is controlled as a function of the pressure or the pressure is controlled as a function of the temperature as called for in claim 1890, and as taught by Elkins, in order to prevent overheating.

Claim 1890 recites, in part "further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure." The features of claim 1890, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959), MPEP § 2143.01.

Tsai states:

The pretreatment and conditioning of the swelling coal before the in situ combustion and gasification procedure is initiated involves the injection of heated air into the injection hole at sufficient pressure to fracture the coal, and the injection of the heated air through the fracture to the production hole without combustion of the coal. The temperature of this heated air should be at least about 100° C. and preferably at least about 150° C. in order to provide an effective pretreatment and conditioning as evidenced by an increased permeability and porosity and a reduced swellability of the coal proximate to the linkage. Since the injection of the heated air should itself not cause the coal to swell, the maximum temperature of the injected air can be up to but not the same as the temperature at which the coal begins to soften, i.e., the softening temperature of the coal. This softening temperature is a property specific to each particular coal (for the determination of the softening temperature of a coal see pages 152-155 of Chemistry of Coal Utilization, Supplementary Volume, 1963, edited by H. H. Lowry). In general, we prefer that the temperature of the heated air be a maximum of about 350° C. and most prefer that the maximum temperature be about 300° C. The range of about 150° C. to about 300° C. is a particularly suitable operating range.
(Tsai, column 3, lines 21-45).

Elkins states:

It is important to control the temperature within the reaction zone. I have found that the minimum temperature of this zone at which combustion normally can be maintained is of the order of approximately 400° F. It is desirable to maintain the temperature higher than this value up to temperatures from 800° F. to 1000° F. When the temperature rises substantially higher than these values, roughly above 1,200° F., combustion takes place too rapidly, the recoverable cracked products are minimized, the liquefaction occurs considerably ahead of the combustion zone, and, in general, the loss of valuable petroleum products in the combustion itself will become sufficiently great to make the process a good deal less economical. Control of the temperature within the reaction zone can be maintained in several ways. The increase in volume of oxygen-containing gas by application of higher injection gas pressure will increase this temperature. The higher temperature is maintained primarily by the fact that the time available for the loss of sensible heat to the formations adjacent and downstream from the combustion zone is minimized. In addition, the higher rate of injection and the increased supply of oxygen at the reaction zone by virtue of the higher pressures consumes additional oil in combustion above that required at lower rates and thereby generates more heat. To keep the temperature from becoming too high, it is possible to dilute the air with inert gas, for example, by separating the inter gaseous products of combustion (principally oxides of nitrogen and carbon) from the produced hydrocarbons, and introducing it into the injection stream. This

> slows down the rate of heat generated and provides additional time for sensible heat loss to adjacent formation as well as to the formation itself in front beyond the combustion zone. Decreasing the injection gas pressure also decreases the combustion zone temperature.
> (Elkins, column 3, lines 13-46).

Tsai appears to teach or suggest the injection of heated air at sufficient pressure to fracture coal, wherein the heated air is at a temperature below the softening point of coal, preferably between about 150° C to about 300° C. Elkins appears to teach or suggest the injection of air to maintain combustion within a formation and a temperature between approximately 400° F and 1000° F. Elkins further appears to teach or suggest decreasing the injection gas pressure to decreases the combustion zone temperature when the temperature rises above 1200° F. Applicant submits that combination of the prior art would change the principle of operation of the prior art invention being modified.

Applicant requests removal of the obviousness rejection of claim 1890.

H. The Claims Are Not Obvious Over Tsai In View of Kasevich Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1891 and 1892 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 4,457,365 to Kasevich et al. (hereinafter "Kasevich"). Applicant respectfully disagrees with these rejections.

The Examiner states:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to have further modified the Tsai method to have included heating at a rate of less than about 10°C per day as called for in claim 1892, in order to achieve more uniform heating. ... It would have been further obvious to one of ordinary skill in the art at the time of the invention to have further modified the Tsai method to have included heating at a rate of less than about 1°C per day as called for in claim 1891, in order to achieve more uniform heating.

Claim 1891 recites, in part "further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis." The features of claim 1891, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

Claim 1892 recites, in part "heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (Cv), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and wherein heating energy/day *(Pwr)* provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate *(h)* of the selected volume is about 10 °C/day." The features of claim 1892, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

In addition, Tsai states:

> Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm^2) and at a rate of about 300 ft^3 /min (8.5 m^3/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm^2) and at a rate of 1,500 ft^3/min (42.5 m^3 /min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well. In situ combustion and gasification continues without plugging until the coal is exhausted in the zone between the wells.
> (Tsai, column 7, line 62 through column 8, line 19).

Kasevich states:

> The process and apparatus for extracting the products of kerogen in situ from an oil shale body by supplying energy selectively to the kerogen by high frequency electric fields in the frequency range between 100 kilohertz and 1000 megahertz at an intensity which heats the kerogen to a temperature range between

> 250° C. and 500° C. to allow pyrolysis of the kerogen prior to substantial heat transfer to the surrounding mineral portions of the oil shale. A plurality of groups of spaced radiators produce the electric fields for heating the kerogen. A dipole radiator in the subsurface formation is supplied with electromagnetic energy through a transmission line from an energy generator on the surface.
> (Kasevich, abstract).

Kasevich further states:

> In dry oil shale, the conductivity continues to be reduced, as shown by the curve portions 108, reaching a minimum approaching, for example, 10^{-4} mhos per meter at a temperature around 250° C. as shown by curve 112. In this region the major portion of the power is absorbed by the kerogen as shown by curve 118, which assumes sufficiently rapid rise in temperature that no pyrolysis has yet taken place and the conductivity of the inorganic or mineral portion of the oil shale approaches 10^{-5} mhos per meter as shown by curve 116.
>
> As shown by the portions of the formation conductivity curves 114, 120, 122, and 124, different radiation rates produce different energy absorption increases with temperature above 250° C. due partly to conversion of the kerogen to higher conductivity products.
> (Kasevich, column 7, line 66 through column 8, line 13).

Tsai appears to teach or suggest igniting a fire in the coal at the bottom of the injection well and waiting for the fire to stabilize. Tsai does not appear to teach, suggest, or provide motivation for controlling the rate of heating. Kasevich appears to teach or suggest heating a formation by providing energy in the form or electric fields, wherein rate of heating is determined by the different inherent conductivities of kerogen and kerogen products. Applicant submits that combination of the prior art would change the principle of operation of the prior art invention being modified.

Applicant requests removal of the obviousness rejection of claims 1891 and 1892.

I. The Claims Are Not Obvious Over Tsai In View of Stoddard Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1907 and 1908 under 35 U.S.C. 103(a) as obvious over

U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 4,463,807 to Stoddard et al. (hereinafter "Stoddard"). Applicant respectfully disagrees with these rejections.

Claim 1907 recites, in part "wherein the produced mixture comprises ammonia, and wherein greater than about 0.05 % by weight of the produced mixture is ammonia." The features of claim 1907, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

Claim 1908 recites, in part "wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer." The features of claim 1908, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

The Examiner states "It is well known that ammonia is a byproduct of such heating of coal. This is taught by Stoddard." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Stoddard for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1883 in view of Tsai.

Applicant requests removal of the obviousness rejection of claims 1907 and 1908.

J. The Claims Are Not Obvious Over Tsai In View of Gregoli Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1912-1915 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 6,016,867 to Gregoli et al. (hereinafter "Gregoli"). Applicant respectfully disagrees with these rejections.

Claim 1912 recites, in part "further comprising altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about

25." The features of claim 1912, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included altering pressure to inhibit production of hydrocarbons having carbon numbers greater than about 25, as called for in claim 1912, in order to improve production." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Gregoli for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1883 in view of Tsai.

Claim 1913 recites, in part "further comprising controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation." The features of claim 1913, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

Claim 1914 recites, in part "providing hydrogen (H_2) to the heated part of the formation to hydrogenate hydrocarbons within the part of the formation; and heating a portion of the part of the formation with heat from hydrogenation." The features of claim 1914, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

Claim 1915 recites, in part "further comprising: producing hydrogen and condensable hydrocarbons from the formation; and hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen." The features of claim 1915, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included recirculating hydrogen

as called for in claims 1913; providing hydrogen as called for in claims 1914; and hydrogenating as called for in claims 1915; in order to reduce the heavy hydrocarbons and to improve production." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Gregoli for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1883 in view of Tsai.

Applicant requests removal of the obviousness rejection of claims 1912-1915.

K. The Claims Are Not Obvious Over Tsai In View of Van Meurs Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1919-1920 and 5396 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 4,886,118 to Van Meurs et al. (hereinafter "Van Meurs"). Applicant respectfully disagrees with these rejections.

Claim 1919 recites, in part "wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well." The features of claim 1919, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included at least about 7 heat sources disposed in the formation for each production well, as called for in claim 1919, in order to improve production." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Van Meurs for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1883 in view of Tsai.

Claim 1920 recites, in part "further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern." The features of claim 1920, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included at least 3 sources in a triangle as called for in claim 1920, in order to increase production." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Van Meurs for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1883 in view of Tsai.

Claim 5396 recites, in part "wherein at least about 20 heaters are disposed in the formation for each production well." The features of claim 5396, in combination with the features of the dependent claim 1919 and the independent claim 1883, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included at least about 20 heat sources for each production well, as called for in claim 5396, based on the desired heating rate and formation heat transmission characteristics." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Van Meurs for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1883 in view of Tsai.

Van Meurs states:

> Even with respect to a five-spot pattern in which a single fluid-producing well is surrounded by four heat-injecting wells, substantially all of the intervening oil

> shale can be both retorted and made permeable. However, the present invention is preferably employed in a series of contiguous seven-- or thirteen-spot patterns--in either of which patterns (particularly in the thirteen-spot pattern) and retorting rate is significantly increased by having each fluid-producing well surrounded by six or twelve heat-injecting wells.
> (Van Meurs, column 8, lines 15-24.)

Applicant discloses in the specification on page 72, lines 20-23, "In some embodiments an appropriate ratio of heat sources to production wells may be about 10:1, 20:1, 50:1 or greater. If larger ratios are used, then project costs tend to decrease since less wells and equipment are needed."

Van Meurs appears to teach or suggest a 4:1 heat sources to production wells or more preferably 6:1 or 12:1 (the higher ratios preferential because of the increased retorting rate). Van Meurs does not appear to teach, suggest, or provide motivation for 20:1 or more heaters to production wells for the purpose of decreasing project costs. Applicant respectfully submits that the Examiner's rejection of the features of claim 5396, in combination with the features of independent claim 1883 and dependent claim 1919 respectively, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

Applicant requests removal of the obviousness rejection of claims 1919-1920 and 5396.

L. The Claims Are Not Obvious Over Tsai In View of Salomonsson Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claim 1921 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 4,886,118 to Van Meurs et al. and further in view of U.S. Patent No. 4,886,118 to Salomonsson (hereinafter "Salomonsson"). Applicant

respectfully disagrees with this rejection.

Claim 1921 recites, in part "further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units." The features of claim 1921, in combination with the features of the independent claim 1883, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been further obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included a unit of a triangular pattern and a repetitive pattern of units as called for in claim 1921; in order to cover the area evenly." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Salomonsson for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1883 in view of Tsai.

Applicant requests removal of the obviousness rejection of claim 1921.

M. <u>The Claims Are Not Obvious Over Tsai Pursuant To 35 U.S.C. § 103(a)</u>

The Examiner rejected claims 1922-1928, 1932-1945, 1948-1950, and 1955-1957 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. Applicant respectfully disagrees with these rejections.

Amended claim 1922 describes a combination of features including: "providing heat from one or more heaters to a part of the formation; allowing the heat to transfer from one or more heaters to the part of the formation to pyrolyze hydrocarbons within the part of the formation." Applicant submits that support for the amendment can be found at least in the specification, thus adding no new matter, on page 40, lines 1-3 "A heat source may also include a heater that may be

configured to provide heat to a zone proximate to and/or surrounding a heating location such as a heater well." Tsai, does not appear to teach or suggest at least the feature of heating at least a portion of a formation with one or more heaters and allowing heat to transfer from the portion of the formation to a part of the formation, in combination with the other features of the claim for at least the reasons stated in Section F. Applicant requests removal of the obviousness rejection of claim 1922 and the claims dependent thereon.

In addition, Applicant respectfully disagrees that many of the claims rejected by the Examiner are anticipated or obvious in light of Tsai. Applicant submits that many of the dependent claims rejected by the Examiner are independently patentable.

For example, the Examiner states "With regards to claim 1884; the Tsai reference fails to explicitly teach the superposition of heat sources. It is apparent that one of ordinary skill in the art would know that the heat sources should be spaced to substantially heat the entire formation." The Applicant respectfully disagrees.

Claim 1923 recites, in part "wherein one or more of the heaters comprise at least two heaters, and wherein controlled superposition of heat from at least two heaters pyrolyzes at least some hydrocarbons within the part of the formation." Applicant submits that support for the amendment can be found at least in the specification, thus adding no new matter, on page 12, lines 16-26. The features of claim 1923, in combination with the features of the independent claim 1922 for at least the reasons stated in Section F as regards claim 1884, do not appear to be taught or suggested by the cited art.

Claim 1924 recites, in part "further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range." The features of claim 1924, in combination with the features of the independent claim 1922 do not appear to be taught or suggested by the cited art.

The Examiner states "With regards to claim 1925, electrical heaters are well known to heat air. It would have been obvious to one of ordinary skill in the art at the time of the invention to have used an electrical heater with the Tsai process as called for in claim 1925, in order to heat the air." Applicant respectfully disagrees.

Claim 1925 recites, in part "wherein one or more of the heaters comprise electrical heaters." The features of claim 1925, in combination with the features of the independent claim 1922 for at least the reasons stated in Section F as regards claim 1886, do not appear to be taught or suggested by the cited art.

The Examiner states "With regards to claim 1926, surface burners are well known to heat air. It would have been obvious to one of ordinary skill in the art at the time of the invention to have used a surface burner with the Tsai process as called for in claim 1926, in order to heat the air." Applicant respectfully disagrees.

Claim 1926 recites, in part "wherein one or more of the heaters comprise surface burners." The features of claim 1926, in combination with the features of the independent claim 1922 for at least the reasons stated in Section F as regards claim 1887, do not appear to be taught or suggested by the cited art.

The Examiner states "With regards to claim 1927, the Tsai reference teaches a flameless combustor (see col. 2, line 32)." Applicant respectfully disagrees.

Claim 1927 recites, in part "wherein one or more of the heaters comprise flameless distributed combustors." The features of claim 1927, in combination with the features of the independent claim 1922 for at least the reasons stated in Section F as regards claim 1888, do not appear to be taught or suggested by the cited art.

The Examiner states "With regards to claim 1928, the Tsai reference teaches a natural distributed combustor (see col. 2, line 32)." Applicant respectfully disagrees.

Claim 1928 recites, in part "wherein the one or more heaters comprise natural distributed distributed combustors." The features of claim 1928, in combination with the features of the independent claim 1922 for at least the reasons stated in Section F as regards claim 1889, do not appear to be taught or suggested by the cited art.

The Examiner states:

> With regards to claim 1932; the Tsai reference does not explicitly teach the transferring by conduction; however this inherent in a solid substance such as coal. Even though the bulk of the heating in the Tsai method may be done by convection; it is apparent that some unfractured coal must remain, and thus the allowing heat to transfer comprises transferring heat substantially by conduction (that is, substantially within the unfractured portions).

Applicant respectfully disagrees.

Claim 1932 recites, in part "wherein allowing the heat to transfer comprises transferring heat substantially by conduction." The features of claim 1932, in combination with the features of the independent claim 1922 for at least the reasons stated in Section F as regards claim 1893, do not appear to be taught or suggested by the cited art.

The Examiner states:

> With regards to claim 1933; the Tsai reference does not teach the thermal conductivity; however, it would have been further obvious to one of ordinary skill in the art at the time of the invention to have practiced the Tsai method in a coal seam having a thermal conductivity of greater than about 0.5W/(m°C) as called for in claim 1933; such a formation would be a desirable choice because it would heat more uniformly.

Applicant respectfully disagrees.

Claim 1933 recites, in part "wherein providing heat from the one or more heaters

comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C)." The features of claim 1933, in combination with the features of the independent claim 1922 for at least the reasons stated in Section F as regards claim 1894, do not appear to be taught or suggested by the cited art.

The Examiner states:

> With regards to claims 1934-1945, 1949, and 1950; the nature of hydrocarbons produced from such heating is highly variable, and dependent upon many factors, not least of which is the characteristics of the coal. The components of the produced mixture are deemed to be the results of design variables, including coal characteristics and temperature. Also, specifically with respect to claims 1937-1939; hydrocarbons produced using the Tsai method inherently have less than 1% nitrogen, oxygen, or sulfur.

Applicant respectfully disagrees.

Applicant submits that the product mixtures recited in claims 1934-1945, 1949, and 1950 would not be producible by carrying out the in situ combustion process of Tsai, for at least the reasons stated in Section F as regards claims 1895-1906, 1910, and 1911. The product mixtures recited in claims 1934-1945, 1949, and 1950 may be produced by controlling and/or modifying formation conditions during treatment to produce the selected results recited in the claims.

Claim 1948 recites, in part "further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute." The features of claim 1948, in combination with the features of the independent claim 1922 do not appear to be taught or suggested by the cited art.

Claim 1955 recites, in part "wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy." The features of claim 1955, in combination with the features of the independent claim 1922 do not appear to be taught or suggested by the cited art.

The Examiner states "With regards to claims 1955 and 1956; the Tsai reference teaches the permeability greater than about 100 md in table 1. The uniform increase in permeability is inherent." Applicant respectfully disagrees.

Claim 1956 recites, in part "wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation." The features of claim 1956, in combination with the features of the independent claim 1922 for at least the reasons stated in Section F as regards claim 1917, do not appear to be taught or suggested by the cited art.

The Examiner states "With regards to claim 1957, although the Tsai reference fails to explicitly disclose a Fischer Assay; it is apparent that the disclosed process will yield greater than 60%." Applicant respectfully disagrees.

Claim 1957 recites, in part "wherein one or more of the heaters comprise surface burners." The features of claim 1957, in combination with the features of the independent claim 1922 for at least the reasons stated in Section F as regards claim 1918, do not appear to be taught or suggested by the cited art.

N. The Claim Is Not Obvious Over Tsai In View of Elkins Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claim 1929 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 2,734,579 to Elkins. Applicant respectfully disagrees with these rejections.

The Examiner states:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to have further modified the Tsai process to have included the temperature is controlled as a function of the pressure or the pressure is controlled as a function of the temperature as called for in claim 1929, and as taught by Elkins, in order to prevent overheating.

Claim 1929 recites, in part "further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure." The features of claim 1929, in combination with the features of the independent claim 1922 for at least the reasons stated in Section G as regards claim 1890, do not appear to be taught or suggested by the cited art.

Applicant requests removal of the obviousness rejection of claim 1929.

O. The Claims Are Not Obvious Over Tsai In View of Kasevich Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1930 and 1931 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 4,457,365 to Kasevich et al. Applicant respectfully disagrees with these rejections.

The Examiner states:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to have further modified the Tsai method to have included heating at a rate of less than about 10°C per day as called for in claim 1931, in order to achieve more uniform heating. ... It would have been further obvious to one of ordinary skill in the art at the time of the invention to have further modified the Tsai method to have included heating at a rate of less than about 1°C per day as called for in claim 1930, in order to achieve more uniform heating.

Claim 1930 recites, in part "further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis." The

features of claim 1930, in combination with the features of the independent claim 1922 for at least the reasons stated in Section H as regards claim 1891, do not appear to be taught or suggested by the cited art.

Claim 1931 recites, in part "heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (Cv), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and wherein heating energy/day *(Pwr)* provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate *(h)* of the selected volume is about 10 °C/day." The features of claim 1931, in combination with the features of the independent claim 1922 for at least the reasons stated in Section H as regards claim 1892, do not appear to be taught or suggested by the cited art.

Applicant requests removal of the obviousness rejection of claims 1930 and 1931.

P. The Claims Are Not Obvious Over Tsai In View of Stoddard Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1946 and 1947 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 4,463,807 to Stoddard et al. Applicant respectfully disagrees with these rejections.

Claim 1946 recites, in part "wherein the produced mixture comprises ammonia, and wherein greater than about 0.05 % by weight of the produced mixture is ammonia." The features of claim 1946, in combination with the features of the independent claim 1922, do not appear to be taught or suggested by the cited art.

Claim 1947 recites, in part "wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer." The features of claim 1947, in combination

with the features of the independent claim 1922, do not appear to be taught or suggested by the cited art.

The Examiner states "It is well known that ammonia is a byproduct of such heating of coal. This is taught by Stoddard." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Stoddard for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1922 in view of Tsai.

Applicant requests removal of the obviousness rejection of claims 1946 and 1947.

Q. The Claims Are Not Obvious Over Tsai In View of Gregoli Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1951-1954 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 6,016,867 to Gregoli et al. Applicant respectfully disagrees with these rejections.

Claim 1951 recites, in part "further comprising altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25." The features of claim 1951, in combination with the features of the independent claim 1922, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included altering pressure to inhibit production of hydrocarbons having carbon numbers greater than about 25, as called for in claim 1951, in order to improve production." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Gregoli for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1922 in view of Tsai.

Claim 1952 recites, in part "further comprising controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation." The features of claim 1952, in combination with the features of the independent claim 1922, do not appear to be taught or suggested by the cited art.

Claim 1953 recites, in part "providing hydrogen (H_2) to the heated part of the formation to hydrogenate hydrocarbons within the part of the formation; and heating a portion of the part of the formation with heat from hydrogenation." The features of claim 1953, in combination with the features of the independent claim 1922, do not appear to be taught or suggested by the cited art.

Claim 1954 recites, in part "further comprising: producing hydrogen and condensable hydrocarbons from the formation; and hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen." The features of claim 1954, in combination with the features of the independent claim 1922, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included recirculating hydrogen as called for in claims 1952; providing hydrogen as called for in claims 1953; and hydrogenating as called for in claims 1954; in order to reduce the heavy hydrocarbons and to improve production." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Gregoli for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1922 in view of Tsai.

Applicant requests removal of the obviousness rejection of claims 1951-1954.

R. The Claims Are Not Obvious Over Tsai In View of Van Meurs Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1958-1959 and 5397 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 4,886,118 to Van Meurs et al. Applicant respectfully disagrees with these rejections.

Claim 1958 recites, in part "wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well." The features of claim 1958, in combination with the features of the independent claim 1922, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included at least about 7 heat sources disposed in the formation for each production well, as called for in claim 1958, in order to improve production." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Van Meurs for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1922 in view of Tsai.

Claim 1959 recites, in part "further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern." The features of claim 1959, in combination with the features of the independent claim 1922, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included at least 3 sources in a triangle as called for in claim 1959, in order to increase production." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Van Meurs for the reasons

cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1922 in view of Tsai.

Claim 5397 recites, in part "wherein at least about 20 heaters are disposed in the formation for each production well." The features of claim 5397, in combination with the features of the dependent claim 1958 and the independent claim 1922 for at least the reasons stated in Section J as regards claim 1920, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included at least about 20 heat sources for each production well, as called for in claim 5397, based on the desired heating rate and formation heat transmission characteristics." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Van Meurs for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1922 in view of Tsai.

Applicant requests removal of the obviousness rejection of claims 1958-1959 and 5397.

S. The Claim Is Not Obvious Over Tsai In View of Van Meurs and Salomonsson Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claim 1960 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 4,886,118 to Van Meurs et al. and further in view of U.S. Patent No. 4,886,118 to Salomonsson. Applicant respectfully disagrees with this rejection.

Claim 1960 recites, in part "further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive

pattern of units." The features of claim 1960, in combination with the features of the independent claim 1922, do not appear to be taught or suggested by the cited art.

The Examiner states "It would have been further obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included a unit of a triangular pattern and a repetitive pattern of units as called for in claim 1960; in order to cover the area evenly." Applicant respectfully disagrees. In addition, Applicant submits that citing Tsai in view of Salomonsson for the reasons cited by the Examiner does not overcome the arguments, herein above, made by Applicant concerning the Examiner's rejection of independent claim 1922 in view of Tsai.

Applicant requests removal of the obviousness rejection of claim 1960.

T. The New Claims Are Not Anticipated or Obvious in view of the Cited Art

Claim 5406 describes a combination of features including: "providing heat from one or more heat sources to a part of the formation, wherein the heated part of the formation is proximate the heat sources; allowing the heat to transfer from one or more heat sources to a pyrolysis zone to pyrolyze hydrocarbons within the pyrolysis zone; wherein at least some hydrocarbons within the pyrolysis zone have an initial atomic hydrogen to carbon ratio greater than about 0.70; wherein the initial atomic hydrogen to carbon ration is less than about 1.65; and producing a mixture from the formation." Applicant submits that the cited art does not appear to teach or suggest all of the features in claim 5406 and the claims dependent thereon.